Figs. ~~3G1 and 3G2~~ 3G1A through 3G2B, taken collectively, provide a table setting forth various physical and optical parameters characteristic of the holographic laser scanning disc employed in the illustrative embodiment of the bioptical holographic laser scanning system of the present invention;

C2 cont

~~Fig. 3H provides~~ Figs. 3H1 through 3H3, taken collectively, provide a table setting forth the holographic exposure/recording angles (i.e. facet construction parameters) for mastering at 488 nanometers the holographic laser scanning disc employed in the illustrative embodiment of the bioptical holographic laser scanning system of the present invention;

~~Fig. 3I provides~~ Figs. 3I1 and 3I2, taken together, provide a table setting forth the "modified" holographic exposure/recording angles (i.e. facet construction parameters) for mastering at 488 nanometers the holographic laser scanning disc employed in the illustrative embodiment, while correcting/compensating for post-processing residual gelatin swell associated with the holographic recording medium;

On Page 20, amend the first and third paragraphs as follows:

C3

~~Fig. 3J provides~~ Figs. 3J1 and 3J2, taken together, provide a table setting forth parameters used to analyze the focus shift and out-of-focus spot size for a converging laser reference beam;

C4

Figs. ~~3L1 and 3L2~~ 3L1A through 3L2B, taken ~~together, provides~~ collective, provide a table setting forth CDRH/IEC calculations which verify that the bioptical holographic laser scanning system of the illustrative embodiment satisfies Laser Class requirements;

On Page 69, amend the fourth paragraph as follows:

C5

~~Fig. 9 is~~ Figs. 9A through 9C set forth a spreadsheet-type information table listing calculated parameters used to analyze the light transmission efficiency of the laser scanning beam and calculate the optical power of the laser scanning beam at the data photodetector and the resulting signal levels, for targets located at the local planes and targets located at the maximum depth of field limits of each laser scanning facets;

On Page 72 amend the third and fifth paragraph as follows:

C6

~~Fig. 11A1 is~~ Figs. 11A1A through 11A1H set forth a table setting forth the results of a Truncation Analysis on the effects of diffraction caused by limiting (i.e. truncating) the spot size of a Gaussian laser beam using an aperture-stop, in order to determine the "effective beam diameter" thereof computed in the S and P directions at the collimating lens employed in each laser beam production module within the bioptical holographic laser scanning system under design;

C7

Figs. ~~11B1 and 11B2, collectively,~~ 11B1A through 11B2E provide a table setting forth the results of a Gaussian Analysis on laser beam propagation from the laser beam production module under design through an exemplary light focusing facet on the holographic scanning disc under design, in order to determine the diameter of the laser beam computed at different distances from the light focusing facet;

On Page 74, amend the third paragraph as follows:

C8

~~Fig. 13A3 is~~ Figs. 13A3A and 13A3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-4, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-4 projected onto the first non-trimmed planar beam folding mirror in the third mirror group G3 employed in the first laser scanning station ST1;

On Page 75, amend the last paragraph as follows:

C9

~~Fig. 13B3 is~~ Figs. 13B3A and 13B3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-4, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-4 projected onto the second non-trimmed planar beam folding mirror in the third mirror group G3 employed in the first laser scanning station ST1;

On Page 78, amend the second through fifth paragraphs as follows:

~~Fig. 14A1 is~~ Figs. 14A1A and 14A1B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the first non-trimmed planar beam folding mirror in the first mirror group G1 employed in the second laser scanning station ST2;

~~Fig. 14B1 is~~ Figs. 14B1A and 14B1B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the second non-trimmed planar beam folding mirror in the mirror group G3 employed in the second laser scanning station ST2;

~~Fig. 14C1 is~~ Figs. 14C1A and 14C1B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the second end (i.e. the end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the third non-trimmed planar beam folding mirror in the mirror group G3 employed in the second laser scanning station ST2;

~~Fig. 14D1 is~~ Figs. 14D1A and 14D1B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the fourth non-trimmed planar beam folding mirror in the mirror group G3 employed in the second laser scanning station ST2;

On Page 79, amend the third paragraph as follows:

C11

~~Fig. 15A3 is~~ Figs. 15A3A and 15A3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the second end (i.e. the end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the first non-trimmed planar beam folding mirror in the third mirror group G3 employed in the fourth laser scanning station ST4;

On Page 80, amend the first and fourth paragraphs as follows:

C12

~~Fig. 15B3 is~~ Figs. 15B3A and 15B3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the second non-trimmed planar beam folding mirror in the third mirror group G3 employed in the fourth laser scanning station ST4;

C13

~~Fig. 15C3 is~~ Figs. 15C3A and 15C3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z) coordinates of the vertices of scanning facet Nos. 1-6 projected onto the third non-trimmed planar beam folding mirror in the third mirror group G3 employed in the fourth laser scanning station ST4;

On Page 81, amend the second paragraph as follows:

C14

~~Fig. 15D3 is~~ Figs. 15D3A and 15D3B set forth a spreadsheet table listing (i) the (x,y,x) coordinates specifying the elevation and skew angles of the diffracted laser beams produced at the start (i.e. first end) portion of scanning facet Nos. 1-6, the middle portion of these scanning facets, and the end (i.e. the second end) portion of the scanning facets, and (ii) the (x,y,z)

C14' cont

coordinates of the vertices of scanning facet Nos. 1-6 projected onto the fourth non-trimmed planar beam folding mirror in the third mirror group G3 employed in the fourth laser scanning station ST4;

On Page 87, amend the last paragraph as follows:

C16

As schematically illustrated in Fig. 3A1, each facet on the holographic scanning disc 30 is assigned a unique facet number. As indicated in the table of Fig. 3A4, scanning facets assigned numbers 7, 9 and 11 in the illustrative design are classified into a first facet group (i.e. class) indicated by G1, as each scanning facet in this first facet group has both High Elevation (HE) angle characteristics and Left (i.e. negative) Skew (LS) angle characteristics as indicated in the spreadsheet disc design parameter table of Figs. ~~3G1 and 3G2~~ 3G1A through 3G2B. Facets assigned numbers 8, 10 and 12 are classified into a second facet group indicated by G2, as each scanning facet in this second facet group has both High Elevation (HE) angle characteristics and Right Skew (RS) angle characteristics, as indicated in the spreadsheet disc design parameter table of Figs. ~~3G1 and 3G2~~ 3G1A through 3G2B. Facets assigned numbers 1-6 are classified into the third facet group, as each scanning facet in this third facet group has both Low Elevation (LE) angle characteristics and Left Skew (LS) angle characteristics, as indicated in the spreadsheet disc design parameter table of Figs. ~~3G1 and 3G2~~ 3G1A through 3G2B. By virtue of such characteristics, the scanning facets in each of these three different facet groups produces an outgoing laser beam that is diffracted along a different direction of skew, and therefore, is designed to cooperate with a different group of laser beam folding mirrors in order to generate particular components of the complex omnidirectional laser scanning pattern of the present invention. Such features of the bioptical holographic scanning system of the present invention will be illustrated in great detail hereinafter.

[On Page 88, amend the first and last paragraph as follows:]

In addition, the holographic scanning disc 30 preferably includes scanning facets with symmetrical LS and RS angle characteristics. For example, as illustrated in ~~Fig. 3A4 and 3G2~~ Figs. 3A4, 3G2A and 3G2B, facets 7, 9 and 11 have LS angle characteristics (+28 degrees) that are symmetrical with respect to the RS angle characteristics (-28 degrees) of facets 8, 10 and 12,

respectively. Such features enable different laser scanning stations to produce substantially similar scanning patterns. Figs. 5B4 and 5L3 illustrate this feature. More specifically, Fig. 5B4 illustrates the scanning pattern produced by facets 7, 9 and 11 in cooperation with laser scanning station ST1. Fig. 5L3 illustrates the scanning pattern produced by facets 8,10 and 12 in cooperation with laser scanning station ST3. Note that these two scanning patterns are substantially similar as shown.

C15 cont

As best shown in Figs. 1D1, 1E, 2B2, 2C1, 2K, 2N, and 2O, the first laser scanning station (ST1) comprises: a first laser beam production module 41A mounted on the optical bench 42 of the system, preferably outside the outer periphery of the holographic scanning disc 30, as shown in Fig. 2A2 and 2B2; a first laser beam directing mirror 43A, disposed beneath the edge of the scanning disc, below the first point of incidence associated with the first scanning station ST1, for directing the laser beam output from the first laser beam production module 41A, through the first point of incidence at a fixed angle of incidence which, as indicated in the spreadsheet of ~~Fig. 3F~~ Figs. 3F1 and 3F2, is substantially equal for each laser scanning station in the system; three groups of laser beam folding mirrors, MG1@ST1, MG2@ST1 and MG3@ST1 which are arranged about the first point of incidence at the first scanning station ST1, and cooperate with the three groups of scanning facets G1, G2 and G3 on the scanning disc, respectively, so as to generate and project different groups of laser scanning planes through the bottom scanning window 16, as graphically illustrated in Figs. 5B1 through 5H5, and vectorally specified in Figs. 6A1 through 6C5; a first light collecting/focusing mirror structure (e.g. parabolic light collecting mirror or parabolic surface emulating volume reflection hologram) 70A disposed beneath holographic scanning disc 30 adjacent the first laser beam directing mirror 43A and first point of incidence at scanning station ST1; a first photodetector 45A disposed substantially above the first point of incidence at scanning station ST1 at a predetermined (i.e. minimized) height above the holographic scanning disc 30; and a first set of analog and digital signal processing boards 50 and 55, associated with the first laser scanning station STI, and mounted within the compact scanner housing, for processing analog and digital scan data signals as described in detail in Applicants' US Patent Application Serial No. 08/949,915 filed October 14, 1997, and incorporated herein by reference, incorporated herein by reference in its entirety.

On Page 102, amend the first full paragraph as follows:

As best shown in ~~Fig. 2H~~ Figs. 2I and 2J2, the parabolic light collecting mirror structure 70A (70B, 70C, 70D) associated with each laser scanning station is disposed beneath the holographic scanning disc, about the x axis of the locally embedded coordinate system of the laser scanning station. While certainly not apparent, precise placement of the parabolic light collecting element (e.g. mirror) relative to the holographic facets on the scanning disc is a critical requirement for effective light detection by the photodetector associated with each laser scanning station. Placement of the photodetector 45A at the focal point of the parabolic light focusing mirror 70A alone is not sufficient for optimal light detection in the light detection subsystem of the present invention. Careful analysis must be accorded to the light diffraction efficiency of the facets on the holographic scanning disc and to the polarization state(s) of collected and focused light rays being transmitted therethrough for detection. As will become more apparent hereinafter, the purpose of such light diffraction efficiency analysis ensures the realization of two important conditions, namely: (i) that substantially all of the incoming light rays reflected off an object (e.g. bar code symbol) and passing through the holographic facet (producing the corresponding instant scanning beam) are collected by the parabolic light collecting mirror; and (ii) that all of the light rays collected by the parabolic light collecting mirror are focused through the same holographic facet onto the photodetector associated with the station, with minimal loss associated with light diffraction and refractive scattering within the holographic facet.

C16

On Page 127, amend the sixth paragraph as follows:

As indicated in Fig. 7F, step C2G of the design method involves confirming that light transmission efficiencies along the outgoing and relative optical paths produce sufficient power levels at photodetection. This step of the method is carried out using the spreadsheet information table set forth in ~~Fig. 9~~ Figs. 9A through 9C.

C17

On Page 128, amend the third and fourth paragraphs as follows:

As illustrated in Fig. 11A1, a spreadsheet-type laser beam truncation analysis program is used to obtain the following measures: (1) the effective beam diameter (i.e. $1/e^2$ diameter) in the S and P polarization directions at the collimating lens within the laser beam production module (LBPM) under design; and (2) light intensity loss characteristics. The fixed input parameters to

C18

this program are VLD output wavelength λ_{VLD} , θ_s, and θ_p; and the variable input parameters are lens parameters such as, for example, focal length (mm), numerical aperture, clear aperture, etc. The output from this program is the effective beam diameter d_e in the S and P directions at the lens, and the light intensity loss ($1/e^2$).

C18, cont

Given the laser and lens parameters, the spreadsheet truncation analysis program calculates the effect of truncation on the laser beam. The final result of the program is an "effective diameter" which is an equivalent 1/e-squared diameter that will produce the same spot at the focal point as the actual truncated laser beam. This is also the beam diameter that will be inserted into the main scanner disc design spreadsheet program. The actual number linked to the main scanner disc design spreadsheet program will be a rounded number. It will usually be rounded up to 0.1 to allow for tolerances. Fig. 11A2 sets forth a graphical plot of data produced by the truncation analysis spreadsheet program when numerically integrating the diffraction equation A(z), as described in ~~Fig. 11A1~~ Figs. 11A1A through 11A1H.

A Gaussian Analysis spreadsheet program, as shown in Figs. ~~11B1 and 11B2~~ 11B1A through 11B2E, is then used to measure the amount of light intensity lost by virtue of truncation and propagation along the outgoing optical paths of the system. In the illustrative embodiment, the Gaussian Beam Analysis spreadsheet program has the following input parameters: wavelength of VLD, effective beam diameter at scanning disc d_e (linked from the Truncation Analysis spreadsheet program), and assumed focal length of the holographic facet(s); the output from the program is the minimum beam spot size at light intensity loss ($1/e^2$) of the outgoing laser beam, and depth of field for each group of holographic facets.

On Page 131, amend the first paragraph as follows:

C19

In the illustrative embodiment, Step C10 is generally carried out by projecting the light collection geometry of each scanning facet (preferably specified by a set of vectors as shown in Fig. 12D) onto the first outgoing beam folding mirror (and each successive beam folding mirror) in the group of beam folding mirrors involved in the generation of each scanning plane from the Laser Scanning Station ST1, and then analyzing such geometrical projections on each given beam folding mirror to find the geometrical boundaries that covers the geometrical projections for the given beam folding mirror. The given beam folding mirror is trimmed such that its outer

C19' cont

periphery corresponds to such geometrical boundaries, thereby minimized surface dimensions of the given beam folding mirror while maximum number of return light rays collected by the beam folding mirror. This geometrical projection process will be described below with reference to Figs. 12A1 through 13D1, for the case addressing Scanning Stations No. 1, in particular. Figs. 12A-12D and ~~14A1-14D1~~ 14A1A-14D1B, address Scanning Station No. 2, whereas Figs. 12A-12D and ~~15A1-15D3~~ 15A1-15D3B, address Scanning Station No. 4.